

REMARKS

1. Preliminary Remarks

a. Status of the Claims

Claims 1-62 are pending in this application. Claims 2, 30-32, 42, 49, 50, 53, and 54 are amended. Claims 4, 20, 21, 28, 29, 48, 51, 52 and 61 are canceled. Applicant hereby requests entry of the amendment and remarks made herein into the file history of this application. Upon entry of the amendments and remarks, claims 1-3, 5-19, 22-27, 30-47, 50, 53-60, and 62 will be pending and under active consideration.

b. Amendment to the Claims

In order to expedite prosecution and without prejudice to seeking claims of similar scope in a continuing application, claims 4, 20, 21, 28, 29, 48, 51, 52 and 61 are canceled. Claims 2 is amended in part to indicate that the reinforcing fibres of the composite material of claim 1 are carbon fibre, ceramic fibres, metal fibres, metal coated reinforcing fibres, or mixtures thereof. Support for amended claim 2 can be found in originally filed claim 4. Claims 30, 32, 54 are amended to correct minor grammatical or dependency and not for reasons of patentability. Claim 31 is amended to be directed to a self-healing composite material comprising a fibre-reinforced polymeric matrix, wherein the polymeric matrix comprises a thermosetting polymer and a thermoplastic polymer that together form a solid solution, and wherein said composite material is provided with means for detection of the presence of at least one damaged area of said composite material. Support for amended claim 31 can be found throughout the specification, for example on page 9, lines 7-13 and page 17, lines 2-10. Claims 42 and 50 are amended in part to be directed to a composite material where the composite material is provided with means for detection in change in resistance of the composite material. Support again can be found on page 9, lines 7-13 and page 17, lines 2-10. Amended claims 49 and 53 are similarly amended to claim 31. No new matter is added through these amendments.

c. Objection to the Claim

On page 2 of the Office Action, the Examiner objects to claims 20, 21, 28, 29, 48, 51, 52, and 61 for being in improper dependent form. As stated above, these claims are canceled without prejudice thereby rendering the objection moot. Claim 42 is objected to because the term “in” in the third line is misspelled. Claim 42 has been amended in part to correct this typographical error thereby overcoming the objection.

d. Nonstatutory Obviousness-Type Double Patenting

On page 5 of the Office Action, the Examiner provisionally rejects claims 1-62 on grounds of nonstatutory obviousness-type double patenting over claims 1-35 of copending U.S. Patent Application No. 11/577,968 (the “’968 Application”). The instant application was filed before the ‘968 Application. Because the instant application was filed earlier, Applicant respectfully requests that the obviousness-type double patenting rejection over the ‘968 Application be withdrawn pursuant to M.P.E.P. § 804.I.B1.

2. Patentability Remarks**a. 35 U.S.C. §112, Second Paragraph**

On pages 2 and 3 of the Office Action, the Examiner rejects claim 4 and 31-47 under 35 U.S.C. §112, second paragraph for allegedly being indefinite. Specifically, the Examiner alleges that claim 4 has a broader limitation reciting carbon fibers, glass fibers, ceramic fibers, metal fibers, and metal coated fibers. The Examiner asserts that claims 31-47 are indefinite because it is unclear if the composite comprises a fiber-reinforced polymeric matrix or is a composite two-part system.

Claim 4 has been canceled and its limitations have been provided in amended claim 2. Applicant submits these amendments overcome the indefiniteness of claims 2 and 4.

Amended claims 31-47 are now directed in part to a self-healing composite material comprising a fibre-reinforced polymeric matrix that has a thermosetting polymer and thermoplastic polymer that together form a solid solution. This composite material is provided with a means to detect a change in resistance of the composite material and this resistance is indicated of at least one damaged area to the composite material. As stated before, support for the amendment can be found at page 9, lines 7-12 and page 17, lines 2-10. Applicant submits these amendments overcome the indefiniteness rejections of claim 31-47. In view of the foregoing, Applicant submits that the rejection of claims 4, and 31-47 under 35 U.S.C. §112, second paragraph has been overcome and should be withdrawn.

b. 35 U.S.C. §102(b)

Turpin, U.S. Patent No. 4,954,195

In paragraph 7 of the office action, the Examiner rejects claims 1-4, 10, 12-16, 18-21, 23, 24, 26-33, 49-52, 54, 55, 57, and 60-62 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,954,195 (hereafter “Turbin”). Specifically, the Examiner asserts that Turbin teaches a process for increasing the damage tolerance in a composite without the loss of possibility or mechanical

properties and concludes that this teaching anticipates the claimed invention. Applicant respectfully disagrees.

The claimed invention is directed to a self-healing composite material comprising a fibre-reinforced polymeric matrix, wherein the polymeric matrix comprises a thermosetting polymer and a thermoplastic polymer that together form a solid solution. Product claim 31 also includes this recitation and method claims 22, 49 and 53 further use the self-healing composite materials including the thermosetting polymer and a thermoplastic polymer that together form a solid solution

In contrast, Turpin is directed to a process for increasing the damage tolerance in thermoset composites by controlled solubility of a thermoplastic filler in the base thermoset. The process involves mixing spherical particles of a selected thermoplastic, e.g. a polyimide, with a hot thermoset resin, such as a bismaleimide, to form a uniform dispersion of the resin mixture. The particles of thermoplastic are non-agglomerating and insoluble in the resin mixture. The hot resin dispersion is then applied to fibre reinforcement of e.g. carbon fibres to form pre-pregs. On curing the thermoset at elevated temperature, the thermoplastic particles dissolve in the thermoset resin, forming a composite with **no definable boundary interfaces** between the thermoplastic and thermosetting resins.

Therefore, Turdin discloses a thermosetting resin with a thermoplastic which is initially dispersed within it, but not dissolved. Consequently there is no suggestion of a “polymeric matrix comprises a thermosetting polymer and a thermoplastic polymer that together form a solid solution” and it is only subsequently, on heating to cure the resin, that the thermoplastic dissolves within the resin. It is noted that the patent discloses, at column 3, lines 3 to 7, that “The result upon curing is that while the cured matrix is **a two phase system**, the structure of the system appears substantially homogeneous, with no hard lines of demarcation from one phase to the other, that is a concentration gradient” (emphasis added).

Clearly, this is quite different to the system defined in the claims of the present application, which are directed towards a **single phase system** that facilitates healing. The two-phase system of Turpin is similar to many others known in the prior art and does not anticipate the presently claimed system. Formation of a two phase system is a relatively easy task for a skilled person, whereas the achievement of a single phase solution of polymers is much more difficult. The fact that the material “appears substantially homogeneous” is very much dependent on the means of analysis, since detection of whether a two phase material is truly homogeneous at very small scales can be extremely difficult. Nonetheless, it is clear that Turpin is not concerned with anything other than

two-phase materials and therefore does not anticipate the claimed invention. In view of the foregoing, Applicant submits that the rejection of claims 1-4, 10, 12-16, 18-21, 23, 24, 26-33, 49-52, 54, 55, 57, and 60-62 under 35 U.S.C. §102(b) as being anticipated by Turpin is overcome and should be withdrawn.

Wiseman, U.S. Patent No. 5,306,773

In paragraph 8 of the Office Action, the Examiner rejects claims 1, 2, 4, 5, 10, 12-16, 18-24 and 26-31 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,306,773 (hereafter “Wiseman”). Specifically, the Examiner asserts that Wiseman discloses a moldable resin composition comprising a thermosetting unsaturated polyester resin and a mixture of thermoplastic polymers of vinyl acetate and epoxy resin and concludes that this teaching anticipates the claimed invention. Applicant respectfully disagrees.

Wiseman teaches a resin composition, moldable at room temperature, which comprises a thermosetting unsaturated polyester resin, a mixture of thermoplastic polymers of vinyl acetate and an epoxy compound having at least one 1,2-epoxy group per molecule, a dialkyl-p-toluidine accelerator, a low temperature free radical peroxide initiator, and an alkali metal or transition metal compound capable of reacting with the free radical initiator to initiate polymerisation of the unsaturated polyester resin. The resin apparently provides a high quality surface finish in a room-temperature curing resin system. Thus, Wiseman is concerned with low profile additives for unsaturated polyester resins, which provide reduced shrinkage to a molding on curing, thereby facilitating the improved surface finish.

Applicant submits there is no teaching to the effect that the thermoplastic is dissolved in the resin and, even if it was dissolved in the resin, there is no indication that it remains in solution after curing of the resin. Consequently, it appears to teach nothing more than a mixture of thermosetting systems with thermoplastic systems. In contrast, the claimed invention is directed to **a single phase system that has the ability to heal**. There are many systems that phase separate upon curing, as is demonstrated by the existence of much prior art relating to control of phase-separation, whereas the present inventors are concerned with the provision of a system wherein the constituents remain in single-phase solution. Consequently, Wiseman does not anticipate the claimed invention. In view of the foregoing, claims 1, 2, 4, 5, 10, 12-16, 18-24 and 26-31 under 35 U.S.C. §102(b) as being anticipated by Wiseman has been overcome and should be withdrawn.

Chiba, U.S. Patent No. 5,952,435

In paragraph 9 of the Office Action, the Examiner rejects claims 1, 2, 4, 10-16, 18-24, and 26-31 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,952,435 (hereafter “Chiba”). Specifically, the Examiner asserts that Chiba discloses a composite material comprising a mixture of an epoxy resin and aromatic polycarbonate thermoplastic resin as well as a composite comprising a reinforcing fiber wherein the reinforcing fiber is carbon or glass fiber and concludes that this teaching anticipates the claimed invention. Applicant respectfully disagrees.

Chiba is concerned with a composite material for a member of a track belt for use in a snowmobile, the material comprising a glycidylamine epoxy resin that is a polyfunctional epoxy thermosetting resin, a 2-functional epoxy resin, an aromatic polycarbonate thermoplastic resin and an acid anhydride curing agent. The composite material also includes reinforcing fibre. The inventors are concerned with achieving a toughened epoxy resin with a higher temperature capability than existing rubber toughened systems.

It is known to the skilled person that rubber toughening of epoxy resins is specifically achieved by creating a very finely dispersed two phase morphology, with the rubber particles so created acting to divert cracks and pin them. The consequence of this mechanism is the formation of many cracks with complex paths, such that tougher material is obtained. It is clear from this document that the thermoplastic is phase separated and that the inventors have achieved the classic two phase structure desired for rubber toughening. As previously discussed, the claimed invention is not concerned with two-phase structures and provide only a single phase system, which requires dissolution and maintenance of the thermoplastic or linear polymer in solution in the thermosetting polymer in order to provide healing. Consequently, Chiba does not anticipate the claimed invention. In view of the foregoing, 1, 2, 4, 10-16, 18-24, and 26-31 under 35 U.S.C. §102(b) as being anticipated by Chiba has been overcome and should be withdrawn.

3. Conclusion

Applicant respectfully submits that the instant application is in good and proper order for allowance and early notification to this effect is solicited. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the instant application, the Examiner is encouraged to call the undersigned at the number listed below.

Respectfully submitted,

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